# SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY
# VISHNUPURI, NANDED-431606

**Synopsis of the proposed research plan**

**Title of research proposal**

# "MULTILAYER CROPPING FOR ENHANCING RESOURCE UTILIZATION, SUSTAINABLE PRODUCTIVITY AND PROFITABILITY OF FARMERS."

**Submitted for the degree of**

**Doctor of philosophy in**

**Botany**

**Under**

**Faculty of Science and Technology**

**Submitted by**


## Miss. Shivani Sanjay Narlawar

**(M.sc Botany, PET, SET)**


**Under the guidance of**


## Dr. R.V.Sangvikar

**Asst. professor and Research guide,**

**P.G. Department of Botany,**

**N.E.S. Science College, Nanded.**

**Re-accredited with "A" Grade by NAAC (CGPA 3.38)**


**AUGUST -2023**

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## Introduction:

Multi-layer cropping is a system of growing crops together at different heights simultaneously on the same piece of land. It is also referred to as multi-storied cropping or multi-tier cropping. Multilayer is made up of two words :- Multi &layer. Multi means many, and layer means strata of different heights. This type of cropping is mainly practiced in orchards and plantations to make optimum use of solar energy even under high plant density. In the above figure we can see a field of multilayer farming, Here we can see many crops growing together in same field . it is an indoor plantation here bamboo, green net, grass,… etc is used. Indoor farming is beneficial as it protects from excessive sunlight, excessive rain and dew drops .

Multilayer farming is an advance way of integrated farming, which allows to grow multiple crops on the same piece of land in specific time(singh, 2020). It can include Vegetables, flowers, fruits, medicinal plants, crops or big trees. Basically plants of different heights are used. Here, by using advance technologies using vertical and horizontal land along with sunlight and other natural resources, we can use any area to optimize unit production. This is quite well known and true among minor and marginal landholders. Adopting multilayer farming is more competitive than conventional systems. Cultivators can grow 3-4 separate crops under same time and resources.(Rai, 2022).

As population is increasing there is a high demand of food to fulfill this demand traditional farming method is not that much effective to fullfill the demand then we can use multilayer farming method as it requires small area but it gives large production. As now days climate change is major issue so we have to change our cropping pattern to reduce the loss of farmers. The problems like Al- Nino and La- Nina are quite normal these days it affects the rainfall and mansoon so we can use the model of multilayer farming which can be grown in minimum quantity of water. Use of chemicals can br eliminated by using organic methods.

Every individual is aware of the over- population problem, which is increasing due to day by day. Due to rise in population, farmland is growing down. Food shortage in many parts of the world and the threat of insufficient supplies shortly continue to stimulate more intensive agriculture practice, for example, Multilayer cropping. This method will help the farmers get a good yield and more earnings from the same land using the available resources. It also solves the

problem of feeding the growing population due to less availibility of cultivable land(Pramanik, 2022).

As every one of us known that agriculture is the backbone of the Indian economy because more than 75 per cent of Indians depends on agriculture or agro-industries as their income sources. Now, it has come to light that India‘s economic growth is not keeping with the expectations

because lagging of agricultural growth from past years. Agricultural production depends upon two factors, first productivity of the land and the second productivity of the agricultural, first improved a lot but not the second. The other factors which had largely gone against the improvement in the economy of the marginal farmers is the over-population, less price of commodity in market, lack of knowledge in marketing etc. The present mentioned strategies help marginal farmers to raise their income with the available field.In farming system for Crop production there is a need of encouragement towards the adoption of integrated farm practices, methods and technologies which can increase productivity and income in different ways but they are more costlier and ecological protectors. There should be cultivation of cereals, vegetables, fruits and flowers with other farm related systems should be integrated in such a way that even with the loss of one the other should become helping hand to the farmer. Farming which includes cultivation land, dairy farm or poultry etc. that helps the farmers to get more income instead of only cultivation. Similar findings were also observed by Lev and Campbell (1987).

## Review of Literature:

**Jakhar et.al., (2012)** studied Multitier cropping system for profitable resource conservation and sustainable management of sloping lands of eastern India.

**K Sankaranarayanan et.al., (2012)** studied multitier cropping system to enhance utilization, profitability and sustainability of Bt cotton.

**Raghu Rami Reddy and Shaik Mohmmad (2009)** studied that intercropping were observed to serve as an insurance against the menace of pest and disease , vagaries of weather, making fluctuations and help to increase the net profit to growers.

**Woodhead et.al., (1994)** reviewed cropping system in south asia, it was observed that intercropping is a well established practical covering over 12 m ha .

**Anon(2009)** reviewed that the India is second largest producer of vegetables in the world, although the productivity levels of vegetables have increased manifolds, it won't be sufficient to feed ever increasing population as a result of increasing demands. This will complicate the issue of price rise further leading to increased costs of vegetables.

**K. K .Chandra (2014)** studied Evaluation of growth and economic parameters of curcurma longa and amorphophallus paeonifolius intercrops in medium aged pisidium guajava orchad.

**Mina Nath Paudel (2016)** Studied multiple cropping for raising productivity and farm income of small farmers.

**Andrews (1976), Joshi (2007) Degal et.al., (2016)** defined multiple cropping as the intensification of cropping in time and space leading to growing two or more crops on the same field in a year.

**Nimbolkar et,al.,(2016)** studied Multistoried cropping system in horticulture- A Sustainable land use approach.

**Rahim M.A. (1995)** reviewed that a multi-storied approach is often viewed as a sustainable alternative farming system particularly on small and marginal lands and it can provide greater economic return per unit area. Land cultivation through this system can maintain ecological balance besides efficient use of all natural resources.

**Shourov Dutta and Parkey Gogai (2020)** studied multistorey cropping system: A profitable approach for suitable productivity.

**Nikhil Singh(2020)** studied Multilayer farming an advanced intercropping .

**Abha Saxena and Deepti Rai (2022)** studied Multilayer Farming: an initiative towards increasing Farmers income.

**K. Sanskaranarayan et.al., (2011)** studied that by using advanced techniques using vertical and horizontal land along along with sunlight with sunlight and other resources, we can use any area to optimize unit production. Multilayer farming is one of the advanced technologies that involve multi- species cultivation, both annual and perennial, in same field, as a new alternative to sustainable growth for small and marginal farmers that can produce higher economic returns per unit area.

**P. Jakhar et.al.,(2012)** studied that adopting multilayer farming is more competitive than conventional system. Cultivars can grow 3-4 separate crops under 3 tiered structure at the same time using the same resources As an intercrop it will grow profitably in different horticultural crops. These vegetables will rich in Calcium, Phosphorous, Vitamins and other minerals.

**Antara Pramanik (2022)** studied Multi-layer cropping: Ideal approach for better yield and increasing farm income.

## Objectives of research:

- To determine the practicality and viability of implementing a multilayer farming model in the specific agro-climatic conditions of Maharashtra
- To investigate how the multilayer farming approach can maximize the utilization of available land, water, and other resources to enhance agricultural productivity.
- To explore how the model can facilitate the cultivation of diverse crops in multiple layers, leading to improved resilience against pests, diseases, and market fluctuations.
- To examine the economic benefits of the multilayer farming model, including potential income generation, cost savings, and market opportunities for the farmers.
- To evaluate the environmental implications of the model, such as its potential to reduce chemical inputs, conserve water, and promote soil health.
- To investigate how the adoption of multilayer farming can positively impact the livelihoods of small-scale farmers by increasing their income and overall quality of life.
- To develop strategies for sharing information and training farmers about the techniques, best practices, and challenges associated with multilayer farming.
- To examine how the model can foster community participation, knowledge exchange, and collective decision-making among farmers.
- To provide insights and recommendations to policymakers about the potential benefits of supporting and promoting multilayer farming practices in Maharashtra.
- To assess the scalability of the multilayer farming model across different regions of Maharashtra and explore ways to adapt it to various local contexts.

## Methodology:

**Phase 1: Site Selection and Analysis:**

-Suitable locations location will be identified within Maharashtra based on factors like climatic conditions, soil type, water availability, and market proximity.

- A thorough analysis of the chosen site will be conducted to understand its topography, microclimates, and existing vegetation.

**Phase 2: Crop Selection and Planning:**

- A mix of compatible crops will be chosen suitable for vertical or layered cultivation, considering factors like growth rate, light requirements, and water needs.

- Crop rotation and intercropping strategies will plan according to optimize space and resource utilization.

**Phase 3: Design and Infrastructure:**

- The layout of the multilayer farming system will be designed, considering factors such as sunlight exposure, water distribution, and accessibility for maintenance.

- Necessary infrastructure will be set up, including support structures for vertical growth, irrigation systems, and shade nets if required.

**Phase 4: Soil Preparation and Enrichment:**

- The preparation of soil will be done after analyzing its nutrient content and pH levels. Necessary amendments will be made to ensure optimal soil health.

- Incorporation of organic matter, compost, and appropriate fertilizers to enhance soil fertility.

**Phase 5: Planting and Layering:**

- Planting of the crops will started in different layers based on their growth habits. Place taller plants towards the back and shorter ones towards the front to maximize sunlight exposure.

**Phase 6: Irrigation and Water Management:**

- Suitable irrigation system will be set up that will caters to the water needs of different crops in various layers.

- Water-saving techniques such as drip irrigation and mulching will be implicated to minimize water wastage.

**Phase 7: Pest and Disease Management:**

- The monitoring of crops should be done regularly for signs of pests and diseases. Implementation of integrated pest management strategies, will be done including natural predators and biological controls.

- Organic pesticides and preventive measures will be measured to maintain a healthy crop environment.

**Phase 8: Crop Care and Maintenance:**

- Adequate support will be provided to climbing plants and regularly prune to manage growth and ensure proper air circulation.

- Monitoring and managing nutrient levels through foliar sprays or controlled-release fertilizers will be done.

**Phase 9: Harvesting and Marketing:**

- Crops at their optimal maturity will harvested to ensure quality and taste.

- Marketing strategies will be developed to sell the produce, which could include local markets, farm stands, community-supported agriculture (CSA) programs, or restaurants.

**Phase 10: Data Collection and Evaluation:**

- Detailed records of crop growth, yield, inputs, and challenges faced throughout the process will be kept.

- Continuously observation will be evaluate on the basis of performance of the multilayer farming model, making adjustments based on observations and results.

**Phase 11: Knowledge Sharing and Training:**

- Workshops and training sessions will be organized for local farmers to share knowledge about the multilayer farming techniques and best practices.

- Collaboration and knowledge will be encouraged exchange among farmers implementing the model.

**Phase12: Continuous Improvement:**

- The model based on lessons learned and feedback from farmers, will adapted making improvements over time to optimize the system.

**Phage13: Thesis writing and submission:**

Scientific writing of thesis will be done for final submission to university.

## Importance of study/Society application:

### International status:

Multilayer cropping, also known as intercropping or polyculture, involves growing different crops together in the same field to maximize land use and yield. Its international application and societal benefits include:

- Increased Yield and Resource Efficiency:Multilayer cropping optimizes resource utilization, such as sunlight, water, and nutrients. Countries like **China and India** have extensively studied and adopted this technique to enhance agricultural productivity.
- Diverse Diet and Food Security: Intercropping provides a wider range of crops, contributing to improved nutrition and food security. African nations like **Nigeria** and **Kenya** have explored multilayer cropping to address dietary diversity and reduce vulnerability to crop failures.
- Soil Health and Pest Management:Planting diverse crops can help suppress pests and diseases, reducing the need for chemical pesticides. **Brazil and Indonesia** have looked into multilayer cropping as an alternative to monoculture for sustainable pest management.
- Biodiversity Conservation: Intercropping supports biodiversity by creating varied habitats for beneficial insects and wildlife. European countries like **France and Germany** have studied agroforestry systems that incorporate multilayer cropping for both economic and ecological benefits.
- Climate Resilience:Mixing crops with different growth habits enhances resilience to climate fluctuations. Developing countries such as **Bangladesh and Vietnam** have explored multilayer cropping to adapt to changing climatic conditions.

- Cultural and Traditional Practices: Indigenous communities in countries like **Mexico** and **Peru** have practiced multilayer cropping for generations, preserving traditional agricultural knowledge and enhancing local food systems.

- Economic Viability :Multilayer cropping can offer economic benefits through diversified income streams. **Canada and the United States** have researched intercropping for sustainable farming practices that balance financial and environmental considerations.
- Research and Innovation: Agricultural research institutions in various countries, including **Australia and Japan**, have studied multilayer cropping to develop innovative farming techniques that align with modern sustainability goals.

National Status:

Multilayer cropping, also known as intercropping or mixed cropping, has several societal and national benefits in India. Here are some key points along with examples of places where this practice is applied:

- Increased Productivity: Multilayer cropping optimizes land use by growing multiple crops in the same area. This leads to higher yields and greater food security.Example: **Punjab** - Farmers in Punjab often practice multilayer cropping, such as growing wheat and mustard together, to enhance productivity.
- Diversification of Income: Different crops mature at different times, providing a consistent income source throughout the year. Example: **Karnataka** - In parts of Karnataka, farmers intercrop millets like jowar and ragi with pulses and oilseeds to diversify income.
- Nutrient Management: Combining crops with different nutrient requirements can improve soil health and reduce the need for external fertilizers .Example: **Andhra Prades** - In Andhra Pradesh, farmers combine crops like maize and legumes to enrich the soil naturally.
- 4. Pest and Disease Control:Mixing crops disrupts pest and disease cycles, reducing the risk of large-scale losses. Example: **West Bengal** - Rice and fish farming are intercropped in some areas of West Bengal, minimizing rice pests and providing additional income through fish production.
- 5. Water Use Efficiency: Crops with varying water needs can be grown together, optimizing water usage. Example: **Tamil Nadu** - Multilayer cropping of drought-resistant millets along with pulses helps manage water scarcity.

- 6. Climate Resilience: Diverse cropping systems are better equipped to handle climate fluctuations and extreme weather events. Example: **Uttarakhand** - Mixed cropping of crops like wheat, barley, and potatoes helps farmers adapt to the changing climate.
- 7. Reduced Soil Erosion: The canopy cover provided by different crops protects the soil from erosion .Example: **Meghalaya** - Terrace farming with multilayer cropping, including crops like maize and vegetables, helps prevent soil erosion.
- Preservation of Biodiversity: Growing a variety of crops maintains genetic diversity and safeguards against crop failures .Example: **Nagaland** - Indigenous practices in Nagaland involve intercropping of traditional crops to conserve biodiversity.
- Cultural Significance: Multilayer cropping often aligns with traditional agricultural practices and cultural values. Example: Kerala - In **Kerala**, mixed cropping of coconut, banana, and other fruits is a traditional practice with cultural importance.
- Sustainable Livelihoods: Multilayer cropping supports sustainable farming practices, contributing to the livelihoods of rural communities .Example: **Madhya Pradesh** - In some regions, farmers practice multilayer cropping of legumes and oilseeds for improved livelihoods.

## Significance of the study:

Studying the multilayer farming model in India is significant because it offers several benefits:

1. Increased Productivity: Understanding the dynamics of multilayer farming can lead to improved agricultural productivity by utilizing vertical space efficiently, thus increasing the yield per unit area.
2. Crop Diversity: This model allows for cultivation of different crops on various layers, contributing to enhanced crop diversity, which is crucial for food security, nutrition, and resilience against pests and diseases.
3. Year-round Yields: Multilayer farming can potentially provide year-round yields, reducing seasonal fluctuations and ensuring a consistent supply of agricultural products.
4. Resource Efficiency: Researching this model can promote efficient use of resources like water, fertilizers, and energy, aligning with sustainable agricultural practices.
5. Income generation: Implementing multilayer farming can potentially improve farmers' incomes by optimizing land use and diversifying revenue streams.
6. Climate Resilience: By maximizing land use and diversifying crops, multilayer farming can make farming systems more resilient to the impacts of climate change.
7. Rural Employment: Successful adoption of this model can generate additional employment opportunities, contributing to rural livelihoods.
8. Reduced Environmental Impact: Properly managed multilayer farming can lead to reduced use of land and water resources compared to traditional farming methods, thus helping in conservation efforts.
9. Technology Integration: Studying this model encourages the integration of modern technologies like hydroponics, vertical farming, and precision agriculture, leading to innovation and advancements in the agricultural sector.

10. Policy Formulation: Insights gained from studying multilayer farming can inform policymakers in crafting strategies to promote sustainable agriculture and address food security challenges.

## Proposed work plan/Formulation and structure of study: Year wise plan of work and target to be achieved

| Sr. No | Duration | Work to be done | Crop Combination |
|---|---|---|---|
| **1** | **6 month** | **Literature survey, Site Selection, crop selection and planning , soil preparation .** | **-** |
| **2** | **12 month** | **Sowing /Planting the crops, Water management, weed management, Pest and disease management, Harvesting and Marketing. (Rabi Season)** | **Gram + cucumber +Fenugreek + Moringa ( 4 layer )** |
| **3** | **18 months** | **Sowing /Planting the crops, Water management, weed management, Pest and disease management, Harvesting and Marketing. ( Kharif Season)** | **Soyabean + Coriander +Spiny Gourd+Papaya (4 layer)** |

| | | | |
|---|---|---|---|
| **4** | **24 months** | **Sowing /Planting the crops, Water management, weed management, Pest and disease management, Harvesting and Marketing. (Rabi Season)** | **Gram + cucumber +Fenugreek + Moringa ( 4 layer )** |
| **5** | **30 months** | **Sowing /Planting the crops, Water management, weed management, Pest and disease management, Harvesting and Marketing. ( Kharif Season)** | **Soyabean + Coriander +Spiny gourd+Papaya (4 layer)** |
| **6** | **36 months** | **Data collection, interpretation and analysis and Thesis writing** | **-** |

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